

What is claimed is:

1. An acceleration/deceleration transient controller for a spark-ignited internal combustion engine having at least one fuel injector, each fuel injector having
5 an inlet end and an outlet end, the inlet end in fluid communication with a fuel source, comprising:
 - a) at least one fuel conditioner having a fuel heater in fluid communication with said fuel source and said outlet end of said at least one fuel injector; and
 - 10 b) an electronic control unit controlling said fuel heater to reduce transients.
2. The transient controller of claim 1, wherein said at least one fuel conditioner having a fuel heater is comprised of one or more capillaries.
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3. The transient controller of claim 2, wherein said capillaries are made from stainless steel or Inconel™ tubing.
4. The transient controller of claim 3, wherein said tubing is made from a
20 stainless steel composition that includes about 18% chromium and 8% nickel.
5. The transient controller of claim 4, wherein said capillaries have a length in the range of about 1 to 7 inches and an outer diameter of less than about .050 inches.
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6. The transient controller of claim 5, wherein said capillaries have a wall thickness of less than about 0.005 inches.

7. The transient controller of claim 3, wherein said capillaries have a length of about 2 inches, an outer diameter of about 0.030 inches and an inner diameter of about 0.029 inches.

5 8. The transient controller of claim 2, wherein said at least one fuel conditioner having a fuel heater is comprised of four capillaries.

9. The transient controller of claim 8, wherein said capillaries are made from stainless steel or Inconel™ tubing.

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10. The transient controller of claim 9, wherein said tubing is made from a stainless steel composition that includes about 18% chromium and 8% nickel.

11. The transient controller of claim 10, wherein said capillaries have a
15 length in the range of about 1 to 7 inches, and an outer diameter of less than about .050 inches.

12. The transient controller of claim 11, wherein said capillaries have a wall thickness of less than about 0.005 inches.

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13. The transient controller of claim 8, wherein said capillaries have a length of about 2 inches, an outer diameter of about 0.030 inches, and an inner diameter of about 0.029 inches.

25 14. The transient controller of claim 1, wherein said fuel heater is electric.

15. The transient controller of claim 14, wherein said electric fuel heater produces heat by conducting electricity through thin-walled capillaries containing fuel.

16. The transient controller of claim 15, wherein said fuel heater heats the fuel sufficiently enough to produce flash vaporization.

5 17. The transient controller of claim 1, wherein said electronic control unit comprises a conventional fuel injector control section and a transient control section.

18. The transient controller of claim 17, wherein said transient control section further comprises:

- 10 a) a fuel demand less than part load detector;
- b) a lean or rich exhaust gas deviation from stoichiometry greater than selected thresholds detector; and
- c) a logical AND of said detectors to turn on said fuel heater.

15 19. The transient controller of claim 18, wherein said lean or rich deviation from stoichiometry greater than selected thresholds detector uses different thresholds for lean and rich deviation.

20. The transient controller of claim 17, wherein said transient control section further comprises:

- 20 a) an accelerator pedal velocity generator; and
- b) an accelerator pedal velocity greater than a threshold detector that turns on said heater.

25 21. A method of improving the transient response of an internal combustion engine having at least one fuel injector fed by a fuel source, the fuel injector having an inlet end and an outlet end, comprising the steps of:

- 1) providing a fuel conditioner in fluid communication with the fuel source and the outlet end of the at least one fuel injector wherein said fuel conditioner has an electric heater;

- 2) determining if the exhaust gas oxygen level deviates from a stoichiometric condition by more than a threshold value and, if so;
- 3) turning on said electric heater.

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22. The method of claim 21, wherein the fuel conditioner having a fuel heater is comprised of one or more capillaries.

23. The method of claim 22, wherein said capillaries are made from stainless steel or Inconel™ tubing.

24. The method of claim 23, wherein said tubing is made from a stainless steel composition that includes about 18% chromium and 8% nickel.

25. The method of claim 24, wherein said capillaries have a length in the range of about 1 to 7 inches, and an outer diameter of less than about .050 inches.

26. The method of claim 25, wherein said capillaries have a wall thickness of less than about 0.005 inches.

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27. The method of claim 23, wherein said capillaries have a length of about 2 inches, an outer diameter of about 0.030 inches, and an inner diameter of about 0.029 inches.

28. The method of claim 22, wherein the fuel conditioner having a fuel heater is comprised of four capillaries.

29. The method of claim 28, wherein said capillaries are made from stainless steel or Inconel™ tubing.

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30. The method of claim 29, wherein said tubing is made from a stainless steel composition that includes about 18% chromium and 8% nickel.

5 31. The method of claim 30, wherein said capillaries have a length in the range of about 1 to 7 inches and an outer diameter of less than about .050 inches.

32. The method of claim 31, wherein said capillaries have a wall thickness of less than about 0.005 inches.

10 33. The method of claim 28, wherein said capillaries have a length of about 2 inches, an outer diameter of about 0.030 inches, and an inner diameter of about 0.029 inches.

15 34. The method of claim 21, wherein said fuel heater is electric.

35. The method of claim 34, wherein said electric fuel heater produces heat by conducting electricity through thin-walled capillaries containing fuel.

20 36. The method of claim 35, wherein said fuel heater heats the fuel sufficiently enough to produce flash vaporization.

37. The method of claim 21, wherein in step 2, a different threshold is used for a lean condition and a rich condition.

25 38. The method of claim 37, wherein the fuel conditioner having a fuel heater is comprised of one or more capillaries.

30 39. The method of claim 38, wherein said fuel heater is electric and produces heat by conducting electricity through thin-walled capillaries containing fuel.

40. The method of claim 37, wherein said fuel heater heats the fuel sufficiently enough to produce flash vaporization.

41. A method of improving the transient response of an internal combustion engine having at least one fuel injector fed by a fuel source, the fuel injector having an inlet end and an outlet end, comprising the steps of:

- 1) providing a fuel conditioner in fluid communication with the fuel source and the outlet end of the at least one fuel injector, wherein said fuel conditioner has an electric heater;
- 2) determining if the exhaust gas oxygen level deviates from a stoichiometric condition by more than a threshold value and, if so;
- 3) determining if the load on the engine is less than a part load and, if so;
- 4) turning on said electric heater.

42. The method of claim 41, wherein the fuel conditioner having a fuel heater is comprised of one or more capillaries.

43. The method of claim 42, wherein said fuel heater is electric and produces heat by conducting electricity through thin-walled capillaries containing fuel.

44. The method of claim 41, wherein said fuel heater heats the fuel sufficiently enough to produce flash vaporization.

45. The method of claim 41, wherein in step 2, a different threshold is used for a lean condition and a rich condition.

46. The method of claim 45, wherein the fuel conditioner having a fuel heater is comprised of one or more capillaries.

47. The method of claim 46, wherein said fuel heater is electric and produces heat by conducting electricity through thin-walled capillaries containing fuel.

5 48. The method of claim 45, wherein said fuel heater heats the fuel sufficiently enough to produce flash vaporization.

49. A method of improving the transient response of an internal combustion engine having at least one fuel injector fed by a fuel source, the fuel
10 injector having an inlet end and an outlet end, and an accelerator pedal, comprising the steps of:

- 1) providing a fuel conditioner in fluid communication with the fuel source and the outlet end of the at least one fuel injector wherein said fuel conditioner has an electric heater;
- 15 2) determining if the rate of change of the accelerator pedal position in a direction that increases air into the engine is greater than a threshold and, if so;
- 3) turning on said electric heaters.

20 50. The method of claim 49, wherein the fuel conditioner having a fuel heater is comprised of one or more capillaries.

51. The method of claim 50, wherein said fuel heater is electric and produces heat by conducting electricity through thin-walled capillaries containing fuel.

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52. The method of claim 49, wherein said fuel heater heats the fuel sufficiently enough to produce flash vaporization.